

## GB2348661

Publication Title:

Wellheads :casing cutting and removal assembly

Abstract:

Abstract of GB2348661

An assembly allowing the cutting and removing of tubular casing at a (e.g. subsea) wellhead comprises a swivel 20 to rotatably support the assembly from the wellhead. Hydraulic pressure pivots cutters 36 outwards; so that rotation of the assembly cuts through one or more casing(s); and also forces out arms 44 and 48 whose rollers 46, 50 stabilise the rotating cutting operating. Fluid flows through a piston until a drop-in insert creates back-pressure to shift the piston to move gripping surfaces of spear 26 outwards to grip casing, when the cut casing is lifted. The assembly allows cutting and removal of casing in one trip. A seal puller 22 may be incorporated.

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# (12) UK Patent Application (19) GB (11) 2 348 661 (13) A

(43) Date of A Publication 11.10.2000

(21) Application No 0008111.7

(22) Date of Filing 04.04.2000

(30) Priority Data

(31) 60127775 (32) 05.04.1999 (33) US

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**E21B 31/16**

(52) UK CL (Edition R )

**E1F FAW FAW6 FAW8**

(56) Documents Cited

**GB 2259930 A GB 2165286 A EP 0155129 A**

(58) Field of Search

**UK CL (Edition R ) E1F**  
**INT CL<sup>7</sup> E21B**

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(54) Abstract Title

**Wellheads :casing cutting and removal assembly**

(57) An assembly allowing the cutting and removing of tubular casing at a (e.g. subsea) wellhead comprises a swivel 20 to rotatably support the assembly from the wellhead.

Hydraulic pressure pivots cutters 36 outwards; so that rotation of the assembly cuts through one or more casing(s); and also forces out arms 44 and 48 whose rollers 46, 50 stabilise the rotating cutting operating. Fluid flows through a piston until a drop-in insert creates back-pressure to shift the piston to move gripping surfaces of spear 26 outwards to grip casing, when the cut casing is lifted. The assembly allows cutting and removal of casing in one trip. A seal puller 22 may be incorporated.

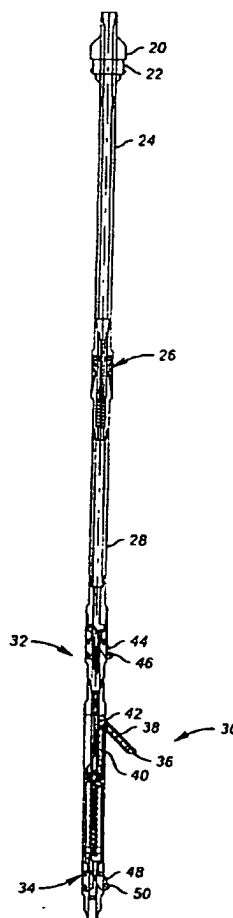
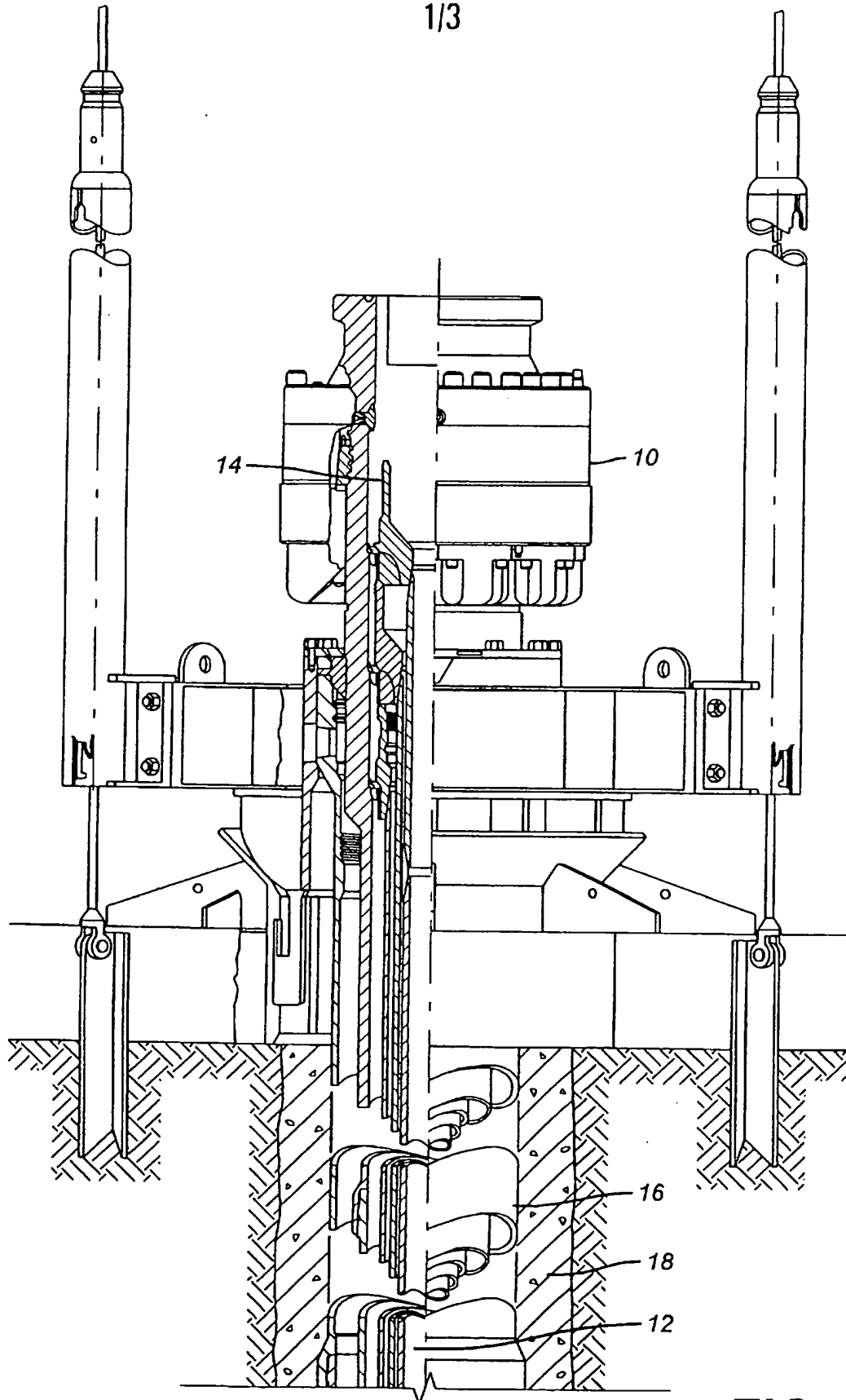


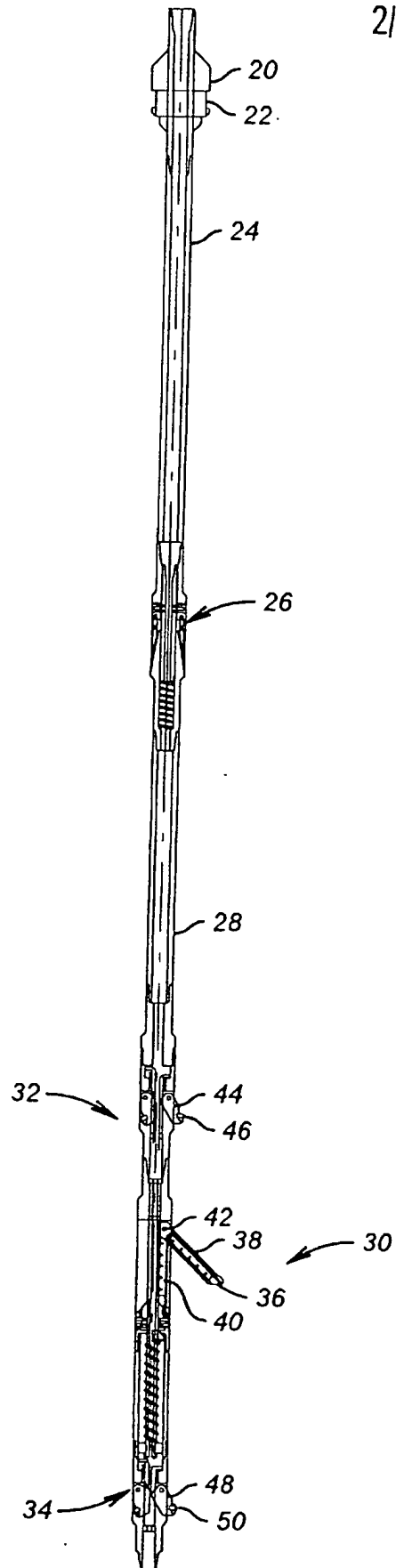
FIG. 2

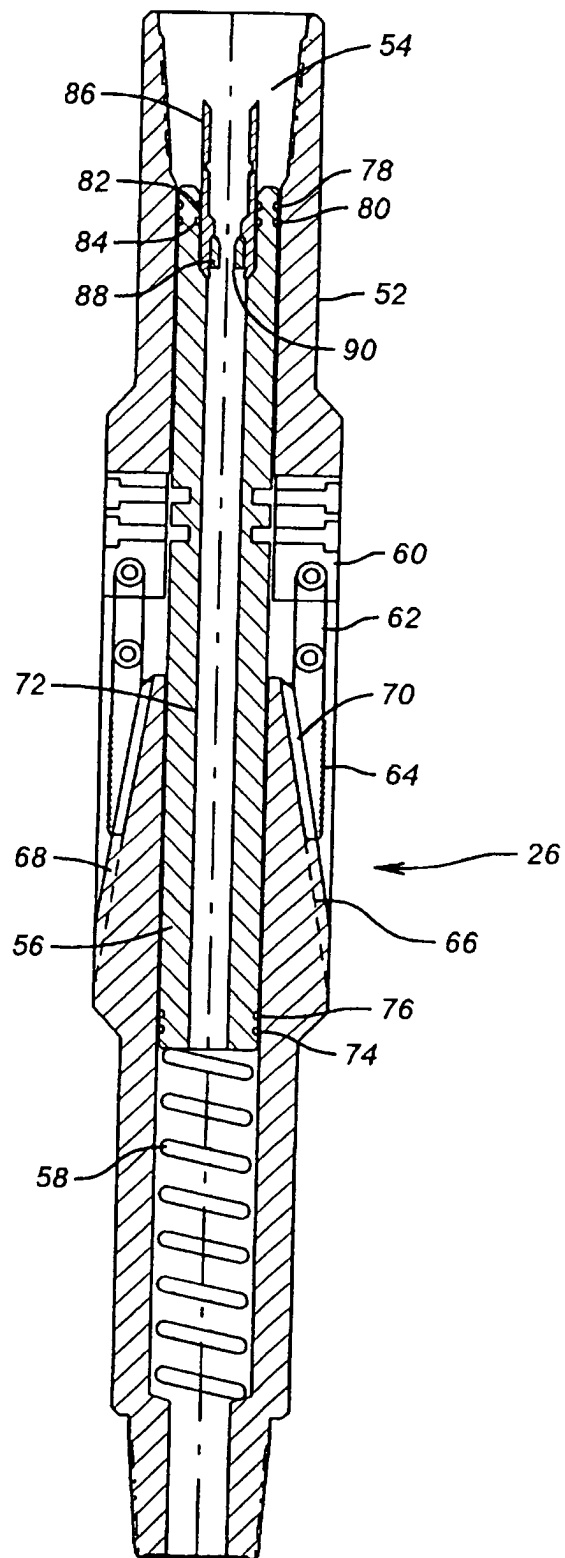
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**FIG. 1**

**FIG. 2**

**FIG. 3**

1           **One-Trip Casing Cutting & Removal Apparatus**

2

3           FIELD OF THE INVENTION

4           The field of this invention relates to  
5 techniques for cutting and removing casing in  
6 a single trip, particularly through subsea  
7 wellheads.  
8

9           BACKGROUND OF THE INVENTION

10          Typical completions involve multiple  
11 casing sizes concentrically mounted and  
12 supported in a wellhead, with each section  
13 having a seal assembly in the wellhead.  
14 Government regulations require removal of  
15 wellheads when the well is no longer in  
16 service. Procedures for accomplishing the  
17 removal of the wellhead would involve an  
18 initial trip to cut the innermost section of  
19 casing using a marine swivel which is  
20 supported by the wellhead. The marine swivel  
21 allows the string with a cutter to rotate  
22 while the exterior of the swivel remains  
23 stationary so that it can be supported by the  
24 wellhead. At the conclusion of this step with  
25 the innermost section of casing cut, the

1 cutter is removed and the seal puller is  
2 installed. It is run into the wellbore for a  
3 second trip to pull the seal for the innermost  
4 casing. Thereafter, a third trip is made with  
5 a spear to grab the cut casing segment and  
6 bring it up out of the well to the surface.  
7 This procedure can be repeated to then remove  
8 the next casing section that is exposed. Each  
9 time the seal puller needs to be a different  
10 size to accommodate the specific casing  
11 section being removed. In the event all the  
12 casing sections are to be cut, the removal of  
13 the seals for each casing size is not  
14 necessary since they will all be removed  
15 together.

16 There are several known spear designs on  
17 the market, such as those now produced by  
18 Baker Oil Tools and referred to as type B, C,  
19 D or E. These designs have exposed grapples  
20 so that if they are rotated, they will tend to  
21 come out radially. Accordingly, such known  
22 prior designs of spears could not be combined  
23 with a single- or multiple-string cutter  
24 because they would snag in the casing as the  
25 cutter tried to rotate.

26 Designs of marine swivels are also known.  
27 One such product is made by Baker Oil Tools  
28 and identified as product No. 170-01. These  
29 marine swivels can be adapted to support a  
30 seal-pulling assembly of different sizes to  
31 accommodate the sequential removal of casing  
32 sections from the wellbore in discrete 3-trip  
33 operations in the prior art.

34 The limitations of some of the spears of  
35 the prior art also included a weight-set  
36 feature which would make them sling out with

1       the application of centrifugal force. This,  
2       again, would detract from their use in  
3       conjunction with any kind of cutter involving  
4       rotation.

5       Accordingly, the objects of the invention  
6       are to reduce rig time, thus saving the well  
7       owner significant quantities of money by  
8       making in one trip what has previously been  
9       done in the prior art in three trips. Another  
10      object of the invention is to combine in one  
11      string a cutter of whatever type, a spear of  
12      whatever type, and seal puller of whatever  
13      type so that in one trip with these components  
14      properly spaced out, the casing section or  
15      sections can be cut, the seal assembly pulled,  
16      and the casing section grappled for removal.  
17      Another object of the invention is to improve  
18      the cutting technique with an improved  
19      actuation system for a multiple string cutter  
20      which involves longitudinal piston movement  
21      moving the cutter in an arcuate motion  
22      outwardly for the cut. Another objective is  
23      to provide wear surfaces on the cutter  
24      elements so that they can be redressed for  
25      reuse. Another objective is to provide  
26      improved stabilizers which are hydraulically  
27      actuated in the preferred embodiment to  
28      improve the cutting speed and precision. Yet  
29      another objective of the present invention is  
30      to design the spear so that the gripping  
31      members or slips are protected and cannot  
32      engage the casing as the cutter is rotated.

33      These objectives of the present invention  
34      will become more readily apparent to those  
35      skilled in the art from a review of the  
36      preferred embodiment described below.

## SUMMARY OF THE INVENTION

A one-trip system for removing casing from a wellhead is described. The string includes a cutting device spaced at the required depth and a grappling device above it at the appropriate location. A swivel tool, such as a marine swivel, is used in conjunction with a seal-pulling assembly so that after cutting the casing, the seal assembly can be pulled without an additional trip into the well. The grappling device or spear can be hydraulically actuated to grab the casing for removal from the wellbore. The spear features a drop-in restrictor which allows sufficient flow during cutting operations with a mechanical cutter without actuating the spear, while at the same time allowing actuation of the spear by circulation after dropping in the restrictor after the casing section has been cut.

## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a sectional elevation of a typical wellhead installation, showing multiple concentrically mounted casing strings.

Figure 2 is a sectional elevational view of the one-trip assembly used for cutting and removal of casing sections from the wellhead.

Figure 3 is a detailed view of the spear of the preferred embodiment, shown in sectional elevation.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Figure 1 illustrates a typical known wellhead assembly, showing a subsea wellhead 10. Figure 1 further illustrates the concentrically mounted casing string starting with casing string 12, which is the smallest. A seal assembly 14 secures the casing string 12 in the wellhead 10. The other strings are similarly situated, with their own seal assemblies. In Figure 1, the outermost section of casing 16 is cemented with cement 18. In between some of the other casing strings can be cemented as well. Figure 2 illustrates the assembly used for one-trip removal of one or more strings, as illustrated in Figure 1. The first string to be removed from the assembly in Figure 1 is casing string 12. The assembly to do this in one trip is shown in Figure 2.

The assembly comprises a marine swivel 20 of known construction. Optionally attachable to it is a seal puller 22. Both the marine swivel 20 and the seal puller 22 are known designs. Below the seal puller 22 is a section of tubing 24 to properly space out the spear 26. The spear 26 is shown in more detail in Figure 3. Below the spear 26 is another section of tubing 28 to properly space out the cutter 30. The cutter 30 has a stabilizer 32 above and 34 below.

In the preferred embodiment shown in Figure 2, the cutter 30 has multiple blades, one of which 36 is shown in Figure 2. The blades can have renewable cutting surfaces 38. A piston 40, which is hydraulically actuated,

1 engages the blades 36 and forces them to  
2 rotate about their respective pivot pins 42.  
3 Hydraulic pressure also forces out arms 44 on  
4 stabilizer 32. Each of the arms 44 has a  
5 roller 46 to engage the casing while the  
6 entire string rotates with respect to the  
7 marine swivel 20.

8 The lower stabilizer 34 is built the same  
9 as the upper stabilizer 32 and operates by  
10 hydraulic actuation to move out arms 48 until  
11 their rollers 50 engage the casing.

12 The operation of the spear is illustrated  
13 in Figure 3. It has a body 52 and a bore 54.  
14 A piston 56 acts against a spring 58 within  
15 bore 54. Attached to the piston 56 is a  
16 sleeve 60 to which are attached slips 62, each  
17 of which has a gripping surface 64. Body 52  
18 has a tapered conical segment 66 which has  
19 opposed grooves 68 which are for the purpose  
20 of retaining tabs 70 on slips 62. Thus,  
21 despite the fact that the body 52 rotates,  
22 centrifugal force will not allow the slips 62  
23 to come out radially. The slips 62 are also  
24 protected by being held in the retracted  
25 position by virtue of their tabs 70 extending  
26 in groove 68 of the conical segment 66 of body  
27 52.

28 Piston 56 has an internal bore 72.  
29 Normally this bore is large enough so that  
30 flow rates anticipated for use in actuating  
31 the stabilizers 32 and 34 and actuating the  
32 blades 36 will not cause the piston 56 to move  
33 downwardly against the opposing force of  
34 spring 58. Piston 56 is sealed in bore 54 by  
35 seals 74, 76, 78 and 80. Bore 72 has seals 82  
36 and 84 adjacent seals 78 and 80 near the upper

1 end. A drop-in restrictor 86 has a narrow  
2 renewable sleeve 88 which has a bore 90. With  
3 the drop-in restrictor 86 seated against seals  
4 82 and 84, flow then has to go through the  
5 narrow bore 90. With sufficient flow through  
6 bore 90, the force of spring 58 is overcome  
7 and the piston 56 is pushed downwardly,  
8 forcing the slips 62 down the conical segment  
9 66. This moves the gripping surfaces 64 into  
10 contact with the casing. Once the gripping  
11 surfaces 64 are in contact with the casing,  
12 further flow is no longer required to hold the  
13 casing with the spear 26. Alternative spear  
14 designs are also within the spirit of the  
15 invention.

16 Accordingly, those skilled in the art can  
17 now readily see how the cutting of a casing  
18 segment supported in a wellbore can be  
19 accomplished in a single trip. The string  
20 shown in Figure 2 properly spaces out the key  
21 components which are the marine swivel 20, the  
22 spear 26, and the cutter 30. The seal puller  
23 22 is secured to the underside of the marine  
24 swivel 20. If all of the strings are being  
25 cut and removed at the same time, the seal  
26 puller 22 can be omitted. In operation, the  
27 method of the present invention involves  
28 lowering the string shown in Figure 2 into the  
29 casing and commencing flow after the marine  
30 swivel 20 comes to rest on the wellhead. Flow  
31 actuates the piston 40 to move the blades 36  
32 pivotally about pivots 42. Rotation of the  
33 assembly through the marine swivel 20 allows  
34 the cutting surfaces 38 to cut through one or  
35 more casing layers. While the cutting is  
36 going on, the arms 44 and 48 extend outwardly

1 due to the flow through the assembly such that  
2 rollers 46 and 50 stabilize the cutting  
3 operation with the cutting surface 38. At the  
4 conclusion of the cutting of the casing string  
5 or strings, the seal assembly 14 is grabbed by  
6 the seal puller 22 and removed. The drop-in  
7 insert 86 is inserted into sealing contact  
8 with seals 82 and 84. Further flow then  
9 creates a backpressure sufficient to overcome  
10 the force of spring 58 to downwardly shift the  
11 piston 56. Downward shifting of piston 56  
12 results in outward movement of the gripping  
13 surfaces 64 on slips 62 until contact with the  
14 innermost casing string is made. An upward  
15 force on the assembly then allows removal of  
16 the cut casing string.

17 Those skilled in the art will appreciate  
18 that other cutting devices can be used, and  
19 the cut can be made chemically or explosively  
20 or by other known techniques. The advantage  
21 of the present invention is that what  
22 previously took three trips into the well now  
23 can be done in a single trip. The spear  
24 design 26 is unique in that it resists outward  
25 movement of the slips 62 when being rotated  
26 during the casing cutting operation with the  
27 cutter 30. The stabilizer design is new and  
28 improved in that the arms are hydraulically  
29 actuated with a piston which longitudinally  
30 moves in response to fluid pressure or flow.  
31 The arms 44 and 48 can flex to handle  
32 imperfections or out-of-round ness in the  
33 casing being cut and to better centralize the  
34 cutter 30.

35 The foregoing disclosure and description  
36 of the invention are illustrative and

1 explanatory thereof, and various changes in  
2 the size, shape and materials, as well as in  
3 the details of the illustrated construction,  
4 may be made without departing from the spirit  
5 of the invention.  
6  
7  
8

CLAIMS

1. A casing cutting and removal assembly for use with multiple tubulars in a wellhead comprising:
  - a cutter selectively engageable to a tubular exposed in the wellhead,
  - a grapple to grab a cut portion of the tubular for removal from the wellhead,
  - a swivel to support said cutter off the wellhead while allowing it to rotate,
  - at least one spacer to properly position said cutter and said grapple with respect to the tubular to be cut so that the tubular can be cut and removed in a single trip.
2. The assembly of Claim 1 further comprising:
  - a seal pulling assembly.
3. The assembly of Claim 2, wherein:
  - said seal pulling assembly is attached to said marine swivel.
4. The assembly of Claim 1, wherein:
  - said cutter comprises at least one cutting blade which is actuable by at least one first piston.
5. The assembly of Claim 4, further comprising:
  - at least one stabilizer for said cutter,
  - said stabilizer comprises at least one arm movable toward the tubular by at least one second piston.
6. The assembly of Claim 5, wherein:

- 1                   said first and second pistons are  
2                   actuatable by flow through said cutter and  
3                   said stabilizer.  
4
- 5           7.    The assembly of Claim 6, further comprising:  
6                   at least two said stabilizers disposed  
7                   uphole and downhole of said cutter.  
8
- 9           8.    The assembly of Claim 7, further comprising:  
10                   a flow passage through said grapple  
11                   which is sufficiently large so as to not  
12                   actuate a grapple piston operably  
13                   secured to it when said first and second  
14                   pistons are activated.  
15
- 16           9.    The assembly of Claim 8, further comprising:  
17                   an insertable restriction into said flow  
18                   passage in said grapple for actuation of  
19                   said grapple piston,  
20                   said grapple piston advancing at least  
21                   one gripper toward the tubular.  
22
- 23           10.   The assembly of Claim 9, wherein:  
24                   said gripper is cammed by said grapple  
25                   piston and further comprises tabs to  
26                   resist outward movement responsive to  
27                   rotation of said grapple.  
28
- 29           11.   The assembly of Claim 10, wherein:  
30                   said stabilizer comprises a plurality of  
31                   arms pivotally mounted and activated by  
32                   said second piston.  
33
- 34           12.   The assembly of Claim 11, wherein:  
35                   said cutter comprises a plurality of  
36                   cutting blades each mounted, removably

1 to a cutting arm which is in turn  
2 pivotally mounted and activated by said  
3 first piston.  
4

5 13. The assembly of Claim 1, further comprising:  
6 a passage through said cutter assembly  
7 and grapple,  
8 said cutter assembly comprising at least  
9 one cutter blade which, responsive to  
10 flow moves toward the tubular before any  
11 response by said grapple.  
12

13 14. The assembly of Claim 13, wherein:  
14 said grapple comprises a gripper which  
15 is urged by flow through said grapple to  
16 move toward the tubular,  
17 said gripper operable after a restrictor  
18 is inserted in said grapple to apply a  
19 force to move said gripper.  
20

21 15. The assembly of Claim 14, wherein:  
22 said gripper is secured to a biased  
23 piston and is mounted adjacent a camming  
24 surface,  
25 whereupon insertion of said restrictor,  
26 flow exerts a force on said biased  
27 piston to overcome said bias and cam  
28 said gripper along said camming surface.  
29

30 16. The system of Claim 15, wherein:  
31 said gripper is retained to said camming  
32 surface against centrifugal force due to  
33 rotation.  
34



Application No: GB 0008111.7

Examiner: G R A H A M  
WERRETT

Claims searched: 1-16

Date of search: 27 July 2000

**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.R): E1F.

Int CI (Ed.7): E21B.

Other:

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
X	GB 2259930 A (HOMCO) see e.g. fig. 3.	1.
X	GB 2165286 A (DEEPWATER) see e.g. Fig. 5.	1.
X	EP 0155129 A2 (MORRIS) see e.g. p. 4, l. 21 on.	1.

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.